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Josef ALDORF[1], **Eva HRUBEŠOVÁ**[2], **Pavel ŠÍPEK**[3]

OPTIMAL STABILIZATION SOLUTION OF THE PIT SITUATED NEAR THE IMPERIAL HOTEL

Abstract

This paper deals with the pit construction of the exit facility, which will serve as an escape route from a sewer collector located in front of the Imperial Hotel in the city centre of Ostrava. The design is based on ground stabilization by means of sheeting, nailing, and anchoring. The pit construction was executed within the project „The enlargement of the sewage network of Ostrava – Stage of construction II – City centre sewer collector – SO 024 escape route of the Imperial Hotel ".

INTRODUCTION

The subject matter of this contribution is a summary of the experience from the realization of the construction pit for the establishment of a discharge chamber for an escape route from the collector. The excavation pit is located in front of the Imperial Hotel in the city centre of Ostrava. Spatially it is attached to an existing object that consists of underground garages for the Imperial Hotel, approx. 4,5 m from the actual hotel building. The bottom of the excavation pit is based approx. 6,0 m under the terrain level, approx. 3,0 m under the level of the foundation base of the Imperial Hotel's adjoining exterior wall. The design of the excavation pit lining is based on ground stabilization by means of nailing and anchoring. The excavation pit was executed within the project „The enlargement of the sewage network of Ostrava – Stage of construction II – City centre sewer collector – SO 024 escape route of the Imperial Hotel."

Construction works were initiated after the realization of the collector tube and of the adjoining chamber K 12 (Zámecká Street); the escape route and discharge chamber are connected to it (Figure 1). Owing to a construction of an adjoining part of the collector and the K12 chamber, decreases of 13,5 mm were observed on the adjoining external wall of the Imperial Hotel. Based on a processed static evaluation, the resulting maximum allowable decrease of the external wall was determined to be max. 25 mm.

TECHNICAL DESCRIPTION – BASIC INFORMATION, CONSTRUCTION OF THE EXCAVATION PIT LINING

The excavation pit was executed in a polygon-like ground-section complying with the section of the construction object of the discharge chamber with a max. ground dimension of approx. 6,5 x 6,0 m. The final construction depth of the excavation pit was approx. 6,0 m under the terrain level.

The lining of the excavation pit was designed and realized by means of nailing (realization of injected nails (anchors) combined with lining by Union bars embedded into horizontal apexes. The horizontal apexes were joined to the injected nail-heads. The technical solution results from a gradual deepening of the excavation pit, level by level and from concurrent realization of reinforcing injected nails anchored over the horizontal apexes from profiled bars U 260 (Figure 2 and 3).

[1] Prof. Ing. DrSc., Department of Geotechnics and Undergroung Structures, Faculty of Civil Engineering, L. Podeste 1875, Ostrava-Poruba, tel.: 596991944, e-mail: josef.aldorf@z
[2] Doc. RNDr.,Ph.D. Department of Geotechnics and Undergroung Structures, Faculty of Civil Engineering, L. Podeste 1875, Ostrava-Poruba,tel.: 596991373, e-mail: eva.hrubesova@vsb.cz
[3] Ing., Geoengineering, Korunní 32, Ostrava–Mar. Hory, tel.:596624091, e-mail: pavel.sipek@geoengineering.cz

In each level the anchors were pre-loaded. They were realized from injected anchor rods TITAN 30/11 in construction lengths of 3,5 to 6,0 m with a similar sloping of 15°. Rapid-hardening injecting cement suspension was used for injecting the nails. The nails were pre-loaded 1 day after installation (injection of the base), after hardening of the base (Figure 2).

There was a technologic screen from the injected pipes realized along the perimeter of the excavation pit (between the hotel wall and the excavation pit) prior to deepening; the spacing of the pipes is 0,25 m each. The injection screen is supposed to be protective and safe. Regarding the geological profile at the construction place (cohesion less soil with gravel from the surface – 3,0 m), it was necessary to ensure the breakup stability prior to deepening, to minimize the risk of disemboguement of the soil into the excavation pit area prior to realization of the final lining (formation of overbreaks) and to ease the area around the soil.

To ensure the full activation of the lining, there was a filling plug put into the vacant interspace by a cement mixture Union (or by a thin cement mortar). The purpose was to ensure full contact between the Union bars and the external separating wall.

The stabilization of the excavation pit bottom was executed during a deepening by means of the installation of 2,0 m long vertical injected nails in the entire excavation pit bottom (1 piece/m^2). In terms of stability, the optimal solution would be to install nails from the penultimate level of deepening (-5,0 m – 4^{th} stage of deepening) in the entire ground extension of the excavation pit bottom. The technologic procedure regarding the stabilization of the bottom was suited to needs and the technical possibilities of the implementer of the construction. The excavation pit bottom was divided into individual segments and the deepening of the excavation pit bottom into the final depth level was done gradually segment by segment. Stabilization of the bottom was realized afterwards, in deepened segments, from the bottom level.

Needling of the existing wall of the VZT engine room and the downhill ramp leading to the garage area was realized gradually with deepening of the excavation pit bottom by a sprayed concrete, onto a welding grid anchored by injected nails (Titan 30/11, length 2,0 m, 1 piece/m^2).

SIMULATION OF TECHNICAL MEASURES IMPACT ON THE MAGNITUDE OF THE IMPERIAL HOTEL FOUNDATION SHIFTING

Proposed technical solution (Figure 1 and 2) was arising from the results of MKP mathematical model that confirmed assumption that reinforcement of the bottom by means of nailing enables it to decrease the magnitude of the vertical settlement by approx. 20% (see Figure 4) and to comply (with some reserve) to tolerance of the additional allowable settlement (max. approx. 10 – 12 mm).

In spite of that, the professional committee had recommended to realize a separating micro pilot wall between the hotel wall and excavation pit (Figure 2) as an additional protective measure. Authors of the contribution therefore realized another mathematical solution that should have confirmed or rejected the assumption regarding the separating wall being a cost effective measure for the limitation of the foundation deformation. Results of the model showed (Figure 5 and 6) that influence of the separating wall is very problematic for the following reasons:

- shifting can decrease to approx. 16 mm (Figure 6) at horizontal shifting without the bottom nailing
- the effect of the independent separating wall is very low at vertical shifting because the maximum magnitude of the settlement is almost the same as in case of the unstabilized pit bottom (Figure 4 and 5).

CONCLUSION

The effect of the separating wall is the biggest and it shows only in combination with stabilization of the bottom when calculating vertical shifting decreases to approx. 1 mm (Figure 5).

This synergic impact of the nailing and separating wall effect can be considered as the most substantial experience from the excavation pit realization.

Measurement results (INSET) confirm this conclusion (see Figure 7). The realization of the excavation pit and angular exit tunnel from the collector took course without extraordinary events and the Imperial Hotel did not suffer nearly any damage during the construction.

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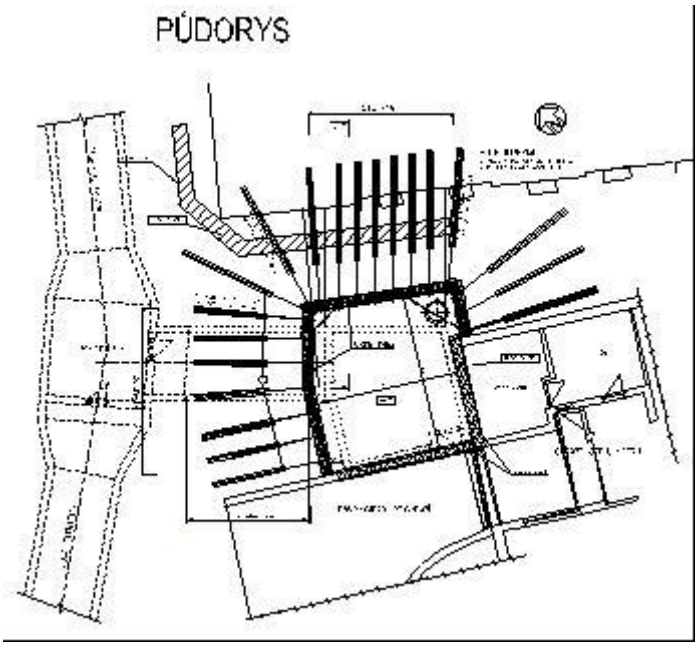

Fig.1 Ground plan of the realized pit and its surroundings

Fig.2 Side view of the pit and its surroundings

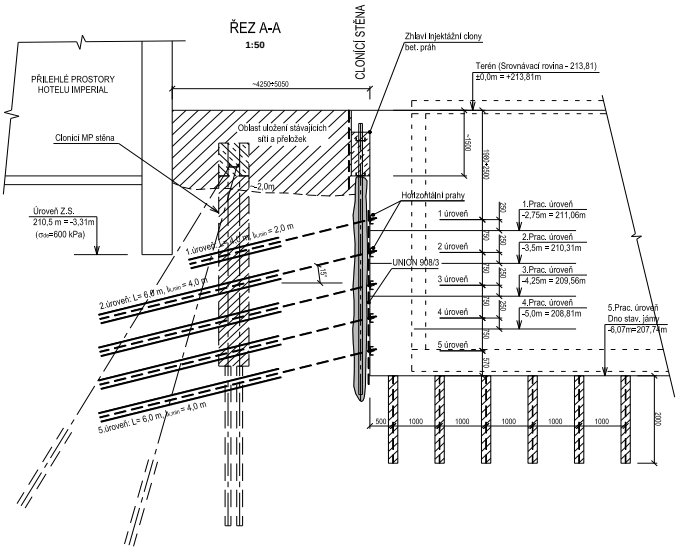

Fig.3 View on the exit of collector opening before the driving

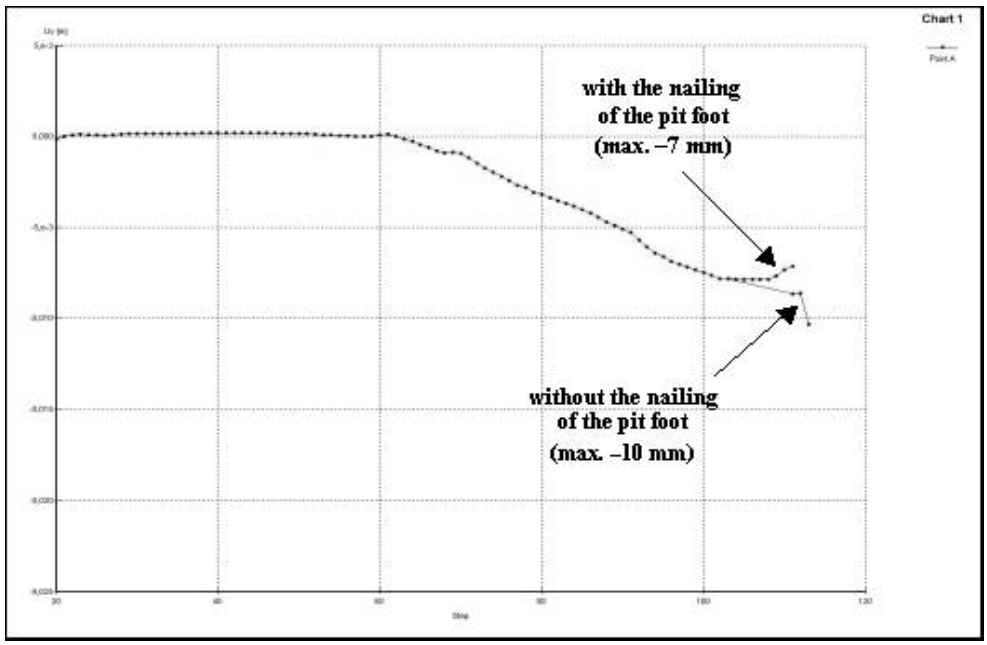

Fig.4 Chart of the vertical displacement in the central point of the Imperial foundation(without the separating wall)

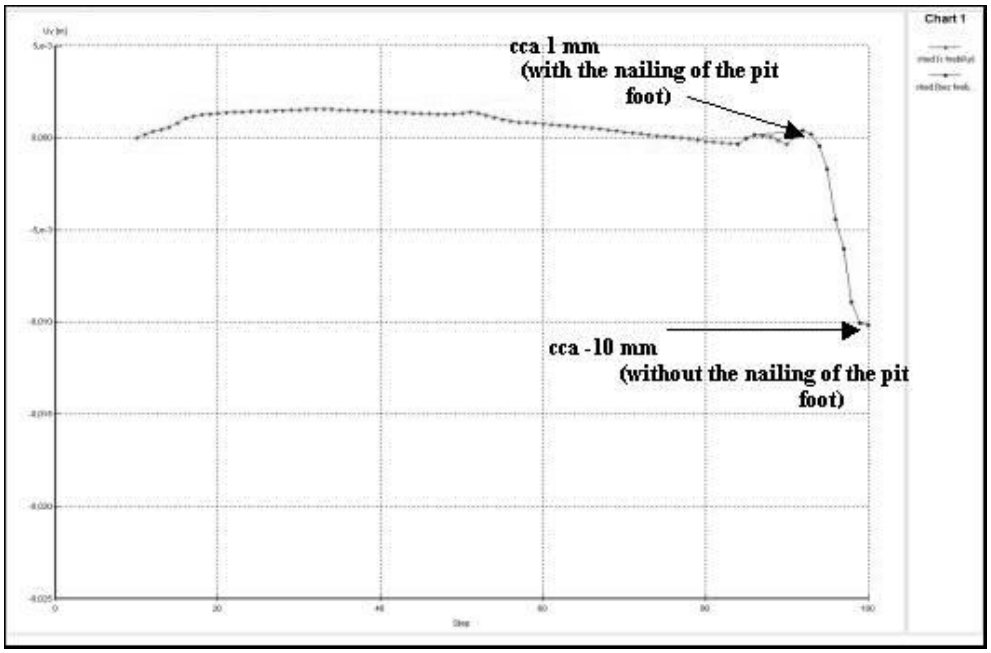

Fig.5 Chart of the vertical displacement in the central point of the Imperial foundation with the influence of the separating wall

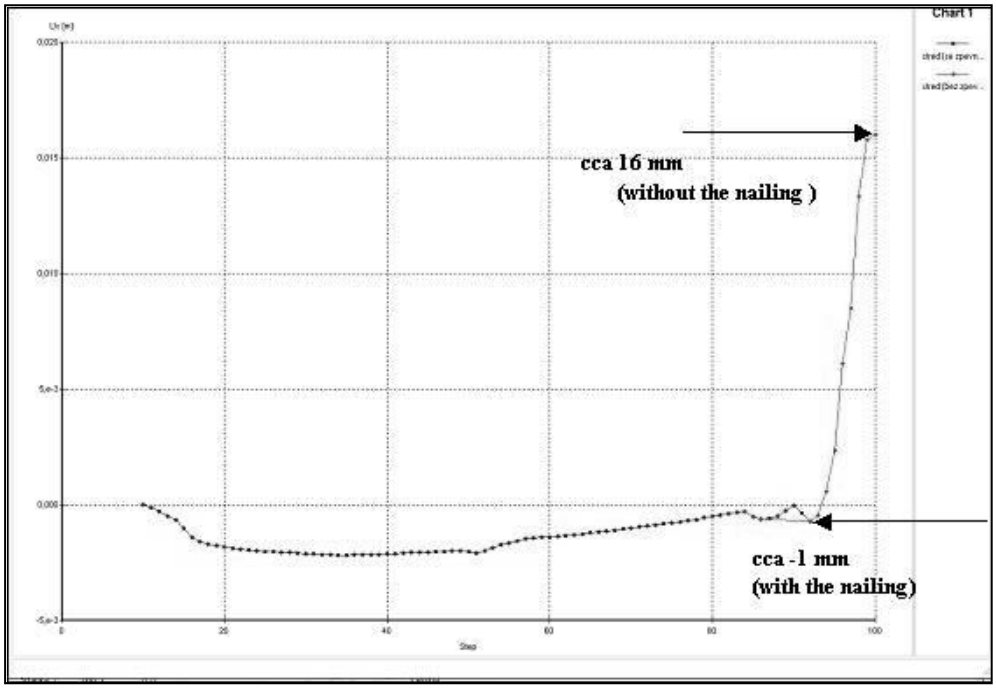

Fig.6 Chart of the horizontal displacement in the central point of the Imperial foundation with the influence of the separating wall

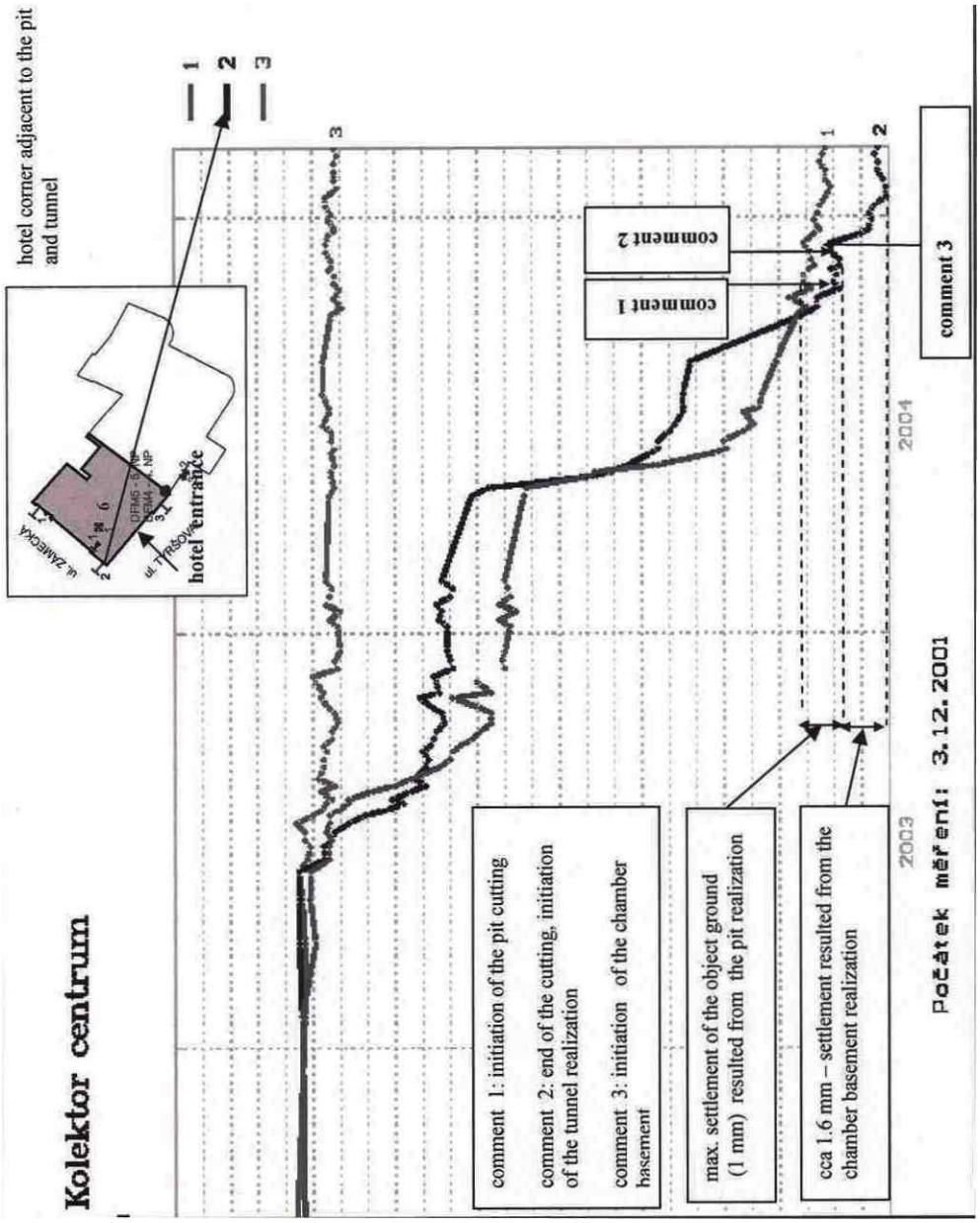

Fig.7 Development of the nivelation measurement during the excavation of the pit